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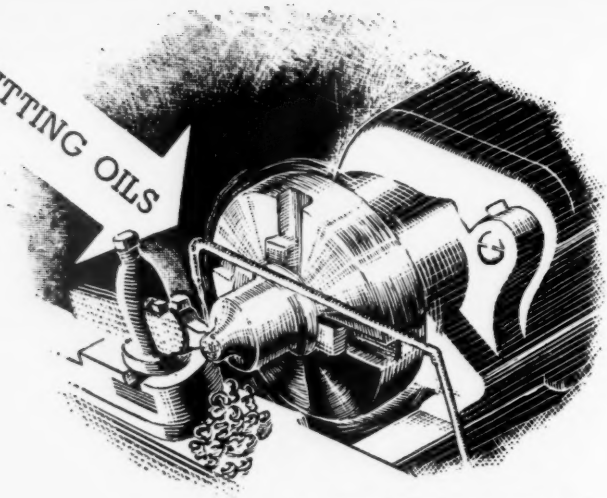

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THE EXAMINATION OF PETROLEUM

The Organization and Function of the Analytical Laboratory

By W. H. THOMAS (Fellow)

Introduction

The essential adjunct of practically all forms of petroleum technology is the analytical laboratory—this is perhaps a truism but one which when even partially disregarded leads to countless troubles in the research station, the development laboratory, the refinery and the distribution installation. The tasks of such a laboratory are multifarious—in the refinery it controls the operation of plants, it ensures the maintenance of product quality, it safeguards the operation of auxiliary plant such as boilers and water softeners and provides a check on the quality of refining reagents. In research and development work it provides the final answer to experiments which may have cost a great expenditure of thought, time and money and in the working of an installation is the means whereby the movement of petroleum, its blending and quality are checked and watched constantly.

The Laboratory

The suitability of a laboratory for the examination of petroleum will depend to some extent on its duties. If its purpose is to service a refinery, then it must be located in a central position with easy access to plant and it should be possible for the sample-man to deliver his samples without actually entering the laboratory. Ample provision for the

storage of samples should be available and situated in close proximity to the sample reception point.

Development and research work requires less consideration of siting but in these cases sample reception is of equal importance and sample storage necessitates even greater consideration.

Allowance must be made in the analytical laboratory building for servicing the engineering side of a petroleum establishment; a close check needs to be kept on boiler water and water-softening process and plant corrosion must be studied and controlled.

Refinery chemicals must be tested for purity, standard solutions must be made up for plant control purposes and from the laboratory apparatus store must be provided all the small pieces of laboratory equipment which the operator requires for checking the operation of his plant.

The next point for consideration is the space requirement for the analytical laboratory. Current opinion in Britain and in the United States is that the minimum laboratory floor space requirement is 140-150 sq. ft. of floor space per laboratory worker, so if we know the number of analysts required we can easily estimate what size our laboratory should be. It should, however, be borne in mind that the laboratory space only represents 60 per cent of the total floor area of the building, the remaining 40 per cent being taken up by offices, corridors, entrance halls, cloak rooms, etc.

The lay-out of benching should be designed according to its proposed use. It may be permanently fixed or may be designed on the basis of service racks with moveable unit-types of benching cupboards, drawers, sinks, hot plates, balance benches, etc. For routine testing purposes, fixed benching is perhaps preferable but there is much to be said for the moveable type because benching rearrangement necessitated by changes in the duties of a laboratory or in the type of apparatus employed can be effected at short notice by the analyst himself. The materials of bench construction (i.e. wood or steel with wood or composition bench tops) are largely a matter of preference and or cost.

When designing a benching arrangement, there is always a tendency to install the maximum amount of benching and not to appreciate, until the laboratory is commissioned, that ample provision should be made for the keeping of analytical records and for the reporting of results. Thus, in a works-laboratory, it is well to provide a place where a chart showing the results of routine tests may be consulted at all times by the operating personnel. Again, the storage of analytical records merits close attention because of the necessity of consulting them at a moment's notice. Should they be located in the laboratory office or actually in the laboratory itself? That depends on circumstances and on the personal view of the chemist in charge.

Of all laboratories, the analytical or testing one should be the cleanest, and it is in the long-run economical to make definite provision for cleaning and maintenance and if necessary to train personnel specifically for this purpose.

The Apparatus

Equipment for the examination of petroleum varies greatly in cost and complexity, but whatever the cost it is sound economy always to purchase the best quality available. It is also "good housekeeping" to ensure the best permanent siting for routine equipment in constant use. Control points, switches, etc., for such equipment should be mounted on panels, electrical wiring should be in conduits and the appearance of the equipment should be sufficiently clean and neat as to be a source of pride to the operator.

Whereas for the purpose of super-

vision it is preferable to house routine testing equipment in large and "open" laboratories with ample room for movement of personnel, specialized equipment such as spectrometers, polarograph and gas analysis apparatus is better located in smaller rooms, each one being fitted for and allocated to a single purpose.

Fuel and lubricant testing engines call for quite specialized laboratory accommodation where sound-proofing and convenience of dismantling are of paramount importance.

In general, the equipment of a petroleum laboratory is becoming more complex year by year; electrically heated and thermostatically controlled baths for the determination of viscosity in fundamental units have largely replaced the Redwood and Saybolt viscometers, the stop-watch is giving place to electronic timing devices and the original Model "A" Podbielniak gas analysis apparatus can scarcely be compared with its modern equivalent which includes the Heligrid column and automatic recording of the results. Aromatic content may be estimated with speed and accuracy by means of the ultra-violet spectrometer, and the use of the photoelectric absorptiometer and the polarograph has accelerated inorganic analysis to an extent undreamed of 20 years ago. Many further examples of this tendency to "mechanization" of testing and analysis can be quoted and it is evident that the advantages of this trend far outweigh the oft quoted disadvantages of mechanization.

Even now in the majority of laboratories, the importance of the storage of temporarily unused apparatus is not fully appreciated. Few laboratories have so much spare bench space that they can afford to leave seldom-used apparatus erected. A convenient room where such equipment can be stored in good condition is, therefore, essential if the waste of time consequent upon repairs and refitting is to be avoided. In the same connexion it is sound economy and indeed it is sound practice to build up an adequate stock of replacement parts as an insurance against the often far-reaching effects of breakage of some essential component.

The Analyst

It will already have been appreciated that the tasks of the analyst in the petroleum industry are by no means limited to oil; modern catalytic processes require inorganic analytical service as do those whose work concerns lubricating oil additives. Catalytic processes also require data respecting particle size, surface activity, porosity, density, etc., used lubricating oils must be inspected and complaints regarding quality must be investigated. A very wide variety of analytical activities must, therefore, be handled by the present day petroleum analyst and, therefore, the staff needs to be selected and trained with far more than average care. A leavening of laboratory workers with experience outside the petroleum industry, for example from steel and chemical works, from public analytical organizations and research institutions, etc., is almost essential if a satisfactory "reservoir" of knowledge, interest and "know-how" is to be obtained.

For certain purposes, experience is of greater value than academic qualifications but of course a combination of these is what any far-seeing works manager would desire and incidentally it is normally the men in possession of both degree and experience who ultimately become the best suited to occupy the senior positions. Many forms of routine testing, although important and essential, do not require any considerable degree of training, and in most refining and distribution centres such work is best carried out by junior testing staff who have at least passed one of the officially recognized school examinations.

Given a group of analytical personnel, properly selected for the tasks involved and well balanced as regards education, experience and qualifications, it is essential to arrange that the activity of each member is changed from time to time. The frequency of change will depend on the degree of responsibility accorded, those holding the most important and responsible jobs being moved with least frequency. These changes not only constitute further training but are also an insurance against boredom and the over-confidence which comes from constant familiarity with standardized procedures.

For the maintenance of general morale, the analyst should be encouraged to make himself fully conversant with the origin and the purpose of the samples which he examines and he should also see before him an avenue of promotion, with definite stages of progress attainable by diligence, accuracy and interest in whatever task is allocated to him.

Having now learnt to work accurately and economically and with adequate speed, the first stage has been passed and it is now necessary for the young analyst to learn the best and most efficacious methods of communicating his results to those who require them. Such reporting in the early stages will probably merely consist of transferring the figures from his note book to a previously prepared form. Subsequently he will be required to say in writing what he has done, what the results were and what conclusions can be drawn. Having learnt to write a report, our analyst still has to master the "art" of controlling staff. This he learns largely by the example of his superiors and the latter should always keep in mind that any defect on their part will ultimately be reflected in the junior's attitude towards his colleagues and workers in inferior positions to his own.

Finally, it is axiomatic that no petroleum analyst (or any other technical worker for that matter) has done his job well unless he has trained a deputy to do his job as well as he himself does it. How otherwise is our analyst to travel along the avenue of promotion if he cannot be released from his present job for want of someone to take his place? From the more practical management view point, however, the deputy is the best insurance against the stoppage or delay of work consequent upon sickness or accident.

The Method

The growth of the petroleum industry has been accompanied by a parallel development of methods for testing petroleum products and derivatives, and such methods of test may be regarded as falling within two categories, namely chemical and physical.

Because of the chemical complexity of petroleum, the development of suitable chemical tests for quality has been somewhat retarded and, in general, such chemical tests that exist have been more concerned with impurities and undesirable constituents than with the more positive aspect of product composition.

With the considerable advance now being made in the chemistry of petroleum, the emphasis in favour of physical tests is, however, undergoing readjustment and analytical data based on chemical composition is becoming of greater utility.

The two chief standardizing bodies—namely the American Society for Testing Materials (A.S.T.M.) and the Institute of Petroleum (I.P.)—are responsible for the devising and issuing of standard methods whether they be analytical procedures or test methods. In addition, various commercial petroleum organizations have their own test-methods books and the petroleum analyst thus has many "method-tools" to his hand which are suitable for most plant and

process control and specification purposes. In general, standard methods of test merely have to be applied according to the printed word, but analytical procedures must be used with intelligence, for in these cases, it is often a particular chemical or chemical compound which is to be determined and the analyst must be aware of the possible effects of the presence of interfering elements.

Even now, after so many years of experience of the examination of petroleum, too little regard is paid to the repeatability and reproducibility of the results of methods of test. It is satisfactory, however, to note that these matters are at last passing into the hands of the statistician and in due course we hope to see the repeatability and reproducibility of our standard methods based on sound statistical conceptions of accuracy.

Apart from the necessity for developing new procedures and methods for the purpose of controlling a new process or a modification of an old one, the established procedures and methods are constantly in need of review and investigation.

An enormous amount of analytical research work, much of it of fundamental nature, has been and is being carried out for the furtherance of the examination of petroleum. Some of the proposed methods involve the use of complex and expensive equipment, such as the mass-spectrometer, the automatic Podbielniak gas analysis apparatus, the infra-red spectrometer, the electron diffraction apparatus, the electron microscope and the X-ray unit.

We must certainly not omit to mention the great mass of work, perhaps of a more practical nature, which deals with the examination of fuels and lubricants in engines.

This activity alone accounts for the expenditure of an enormous amount of engineering effort and is connected with the final testing of petroleum products prior to their sale in the world's markets.

The Result

The results of the examination of petroleum have cost time, effort and money to produce but the final product, frequently consisting of only a few figures, is still valueless unless it is passed expeditiously in suitable form to those who requested it and who will act thereon.

The form of reporting will depend on circumstances but in any case it is most desirable that the matter be given full consideration, particularly as regards records of the telephoning of urgently required results. In general, much time is saved and the possibility of errors in copying or transcription considerably reduced if all methods of reporting are based on printed forms in pads or in books. The latter have the advantage that duplicate carbon copies can be retained in them and when the books are used up they can conveniently be stored for future reference.

For refinery control purposes, the products-inspection-data required for any single plant are frequently quite small in number and are best transmitted on a chit, but it is good practice in addition to record the results on a daily chart, preferably printed and maintained in some easily accessible position in the laboratory where it can be consulted at any time by the plant operating or management staff. Furthermore, it is desirable to review the forms from time to time to ensure that they still satisfy requirements and that any alterations can be made before a request for further printing is made. This review should take place at not less than six-monthly intervals and should include a study of the actual test requirements in order to ensure that no unnecessary work is being carried out. It should also be made in close consultation with those responsible for plant operation.

The reporting of analytical results required by development and research work can also in most cases be effected by means of printed forms, but much

more latitude must be given in the general format.

For routine refinery control purposes it is frequently feasible to maintain records in the form of graphs or charts. These provide an easily appreciated review of plant operations and are of inestimable value when making statistical assessments not only of the work done but also of its accuracy. This pictorial method of presentation has an added value in that the desirable frequency of testing in a refinery can be decided on a sound basis.

With shipment, installation and distribution samples, however, there is little latitude in the matter of testing because such samples must be examined in strict accordance with the methods laid down in the specifications for the materials concerned.

Their Significance and Utilization

Having now obtained the results of the examination of petroleum in properly arranged and equipped laboratories from our trained and experienced chemists, technicians and other laboratory workers, using sound methods of test and analysis and having issued them in correct form to the appropriate individuals or locations, what are the acid tests of the petroleum chemist's work?

These tests may be listed in the form of a number of questions:

(*a*) *Are all the intermediate and final products of the refinery on specification?*

(*b*) *Are the refinery auxiliaries, such as steam generation plant, being properly serviced?*

(*c*) *Are the engineers and plant operators "product quality conscious" because of the co-operation and painstaking work of the petroleum analyst?*

(*d*) *Are the development and research chemists satisfied with the analytical results which are basically the final answers of their experiments?*

(*e*) *Is the distribution organization in a position to handle and transfer its marketable products with confidence that no contamination has occurred and that its wares are "on specification"?*

(*f*) *Are sales problems being solved promptly and efficiently and are they being examined with the celerity which is so vitally necessary if the good name of the refinery's product is to be maintained?*

All these matters are bound up in the final effects of experience in petroleum inspection and a profound knowledge of the significance of tests. This experience and knowledge can only be obtained by close contact with analytical methods and problems and in its broadest applications probably requires more years of training than any other feature of the petroleum technologist's multifarious activities.

[Readers who have practical experience of laboratory organization have doubtless their own methods of dealing with the problems discussed by Mr Thomas. Their views, in the form of correspondence for publication, are welcomed.—Editor.]

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ESSO SHIPPING COMPANY

From January 1, 1950, the ocean tanker fleet of Standard Oil Co. (New Jersey), which totals nearly 900,000 tons and numbers 54 vessels under United States registry, was transferred to a new subsidiary known as Esso Shipping Co. President of the company is Millard G. Gamble ; executive vice-president, John J. Winterbottom; vice-president, John D. Rogers; treasurer - comptroller, Clenton Dewitt; secretary, Edmund A. Flotten. Mr. Gamble will continue to co-ordinate the marine transport owned by foreign affiliates of SOC(NJ), which includes 61 ocean-going tankers (1,030,173 dw tons) and 83 special service tankers (258,556 dw tons).

SECOND OIL SHALE AND CANNEL COAL CONFERENCE

Glasgow, July 3-7, 1950

Plans for the Second Oil Shale and Cannel Conference which, like the first conference held in 1938, is being organized by the Institute of Petroleum, are rapidly taking shape.

A strong Organizing Committee, under the chairmanship of Robert Crichton, J.P., F.Inst.Pet. (managing director of Scottish Oils Ltd.) has been considering the arrangements for the various functions and a Working Committee is dealing with detail. The Organizing Secretary is W. M. Stirling of Scottish Oils Ltd.

The Papers Committee, with Prof W. M. Cumming, O.B.E., D.Sc., F.R.I.C., F.Inst.Pet. (Royal Technical College, Glasgow), as its chairman and Prof H. B. Nisbet, D.Sc., Ph.D., F.R.I.C., A.H.-W.C., F.R.S.E., F.Inst. Pet., as honorary secretary, has been particularly active in the arrangements of the technical sessions. As already announced, the conference will have three main divisions—A. Geology and mining; B. Retorting, refining, and uses of by-products; and C. Economics and statistics.

The list below indicates the papers which have been promised to date and this list shows that the knowledge of oil shale, its winning and treatment, and the utilization of its products will be much advanced as a result of the Conference.

The venue of the Conference is the Royal Technical College, Glasgow, and the technical sessions will be held during the period July 4-6. As 1950 is the centenary year of the James Young patent which brought into being the Scottish Shale Oil industry, the Conference will open with the James Young Centenary Lecture. This will be delivered by Prof W. M. Cumming during a reception at the Royal Technical College on the evening of July 3.

In addition to the technical sessions, arrangements will be made for a tour of the Scottish shale field and the shale works of Scottish Oils Ltd.

On the entertainment side, delegates to the Conference will find much to occupy their spare time. The Lord Provost and Magistrates of the City and Royal Burgh of Glasgow have kindly consented to give a Civic Reception, and a dinner-dance will be arranged. A tour of the Trossachs is being organized for July 7 and the ladies will be specially catered for and shopping and other visits offered.

Details of the various functions are now being worked out and will shortly be circulated to all who have intimated their intention to attend the Conference. Others wishing to be present should notify the Secretary, The Institute of Petroleum, 26 Portland Place, London, W.1, without delay.

Section A—Geology and Mining

(I) Geographical Occurrence and Reserves

(i) Exploitation of oil shale in Australia. C. J. Norcross (National Oil Pty. Ltd.).

(ii) The westward extension of the oil shale field in Central Scotland. J. B. Simpson (Geological Survey of Great Britain).

(iii) Les gisements de schistes en France. M. Schlumberger (Soc. Miniere des Schistes Bitumineux d'Autun).

(II) Geology and Mineralogy

(i) The nomenclature of the canneloid materials. R. A. Mott (British Coke Research Association).

(ii) Geological aspects of the occurrence and origin of New South Wales oil shales. J. A. Dulhunty (University of Sydney).

(III) Mining Methods

(i) Mining of South African torbanite. G. B. Blore and W. B. Somerville (South African Torbanite Mining and Refining Co. Ltd.).

(ii) Longwall working of Broxburn oil shale seam with coal cutters and conveyors. Messrs. Caldwell, Stein, and Keddie (Scottish Oils Ltd.).

(iii) Opencast working of the Middle Dunnet oil shale seam. (Scottish Oils Ltd.)

(iv) Modified pillar and stall working of the Broxburn oil shale seam using conveyors. (Scottish Oils Ltd.)

(v) Electrical installations in the Scottish shale field. G. A. MacLennan (Scottish Oils Ltd.).

(vi) The present position of oil shale technique in the U.S.A. (Union Oil Co. of California.)

(vii) Investigations for the production of oil shale on the commercial scale—Bureau of Mines experimental oil shale mine, Rifle, Colorado. E. D. Gardner and Emery M. Sipprelle (Bureau of Mines).

(viii) Extraction en carrières des schistes pauvres. M. Marecaux (Cie Industrielle de Schistes Bitumineux de l'Aveyron).

SECTION B—RETORTING, REFINING, AND USES OF BY-PRODUCTS

(I) Production of Oil

(i) Recovery and treatment of oil from shale from the Kimmeridge area, Dorset, England. D. MacDougall and C. M. Cawley (Fuel Research Station).

(ii) Retorting of South African torbanite. C. E. Forbes and W. B. Somerville (South African Torbanite Mining and Refining Co. Ltd.).

(iii) Present developments in retorting of oil shale in Scotland. G. H. Smith and A. Ballock (Scottish Oils Ltd.).

(iv) Wartime shale oil production at Marangaroo, N.S.W. G. E. Mapstone (National Oil Pty. Ltd.).

(v) Green River oil shales and products—their character, processing requirements, and utilization. H. M. Thorne, W. I. R. Murphy, K. E. Stanfield, J. S. Ball, and J. W. Horne (Bureau of Mines).

(vi) Retorting Colorado oil shale—a review of the work of the Bureau of Mines. R. A. Cattell and Boyd Guthrie (Bureau of Mines).

(vii) Recherches sur la réactivité du carbone fixe des schistes cuits. Jean Givandon and Andrée Nessler (Institut Français du Pétrole).

(viii) Valorisation integrale des schistes en four gazogene calorifiquement autonome. Jean Givandon and Paul Dumoulet (Institut Français du Pétrole).

(II) Refining of Shale Oil

(i) Refining of crude oil from South African torbanite. G. G. Robertson (South African Torbanite Mining and Refining Co. Ltd.).

(ii) Manufacture of paraffin wax from Scottish shale oil. W. B. Peutherer and G. Grant (Scottish Oils Ltd.).

(iii) Mechanism of the pyrolysis of torbanite. R. F. Cane (Icianz Ltd.).

(iv) Shale oil emulsions and allied problems. G. E. Mapstone (National Oil Pty. Ltd.).

(v) Peculiarities in cracking shale oil. G. E. Mapstone and W. J. Hogan (National Oil Pty. Ltd.).

(vi) Refining Colorado shale oils. Gustav Egloff, J. F. Walter, and H. W. Grote (Universal Oil Products Co.).

(vii) Refining torbanite oils. Gustav Egloff, J. F. Walter, and H. W. Grote (Universal Oil Products Co.).

(viii) Refining Colorado shale oils—a review of the work of the Bureau of Mines. Boyd Morris and J. D. Lankford (Bureau of Mines).

(III) Products and By-Products

(i) Manufacture of bricks from spent shale and hydration of lime for brick-making. Messrs. Anderson and McCallum (Scottish Oils Ltd.).

(ii) Synthetic detergents from Scottish shale oil. D. Stewart and E. McNeill (Scottish Oils Ltd.).

(iii) Chemical composition of Scottish shale oil distillates. S. F. Birch (Anglo-Iranian Oil Co. Ltd.).

(iv) Pyridine bases in Scottish shale oil. R. J. Benzie, J. N. Milne, and H. B. Nisbet (Heriot-Watt College).

(v) The production of gaseous hydrocarbons from cannel coals and their tars. W. L. Wood (British Petroleum Chemicals Ltd.).

(vi) Assaying oil shale. G. E. Mapstone (National Oil Pty. Ltd.).

(vii) Nitrogen in oil shale and shale oil. G. E. Mapstone (National Oil Pty. Ltd.).

(viii) Density-temperature relationships of shale oil products. G. E. Mapstone and H. D. Taskis (National Oil Pty. Ltd.).

(ix) Some properties of crude shale oil and naphtha. G. E. Mapstone (National Oil Pty. Ltd.).

(x) Essai de valorisation des huiles. M. Marecaux (Cie Industrielle des Schistes Bitumineux de l'Aveyron).

(xi) Utilisation des fines de schistes comme combustibles. M. Labourel (Soc. Miniere des Schistes Bitumineux d'Autun).

SECTION C—ECONOMICS AND STATISTICS

(1) The development of the shale oil industry at Glen Davis, N.S.W. (National Oil Pty. Ltd.)

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PETROLEUM FUELS COURSE

A course of six lectures on Petroleum Fuels on Thursdays at 6.30 p.m. will commence at the Sir John Cass Technical Institute on January 12. At each lecture the chair will be taken by Dr E. B. Evans (a vice-president of the Institute of Petroleum) and the subjects are:

General introduction — E. B. Evans. January 12.

Production of petroleum fuels—C. V. Hill. January 19.

Domestic fuels and their uses—L. W. G. Firmin. January 26.

Motor and aviation gasoline and power kerosine—R. Stansfield. February 2.

Diesel and gas turbine fuel—L. D. Derry. February 9.

Fuel oil for steam raising and industrial purposes—G. J. Gollin. February 16.

Fee for the course is 15*s* and applications for enrolment forms should reach the Principal of the Cass Institute, Jewry Street, Aldgate, London, E.C.3, as soon as possible.

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SPELLING OF THE WORD *KEROSINE*

Nearly 25 years ago the American Society for Testing Materials and the Institute of Petroleum agreed to standardize on the spelling of the word "KEROSINE" with the suffix "INE". It was agreed that in petroleum nomenclature the ending "ENE" is generally applied to pure hydrocarbons. Furthermore, since the suffix "INE" is applied to gasoline it should also be applied to kerosine.

The American Society for Testing Materials and the Institute of Petroleum, realizing that there is still not uniformity in the petroleum world regarding the correct spelling of this particular product, desire to reiterate their strong recommendation for international recognition of the spelling KEROSINE.

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Beam Pumping Units.—A new illustrated bulletin covering six National beam counterweighted pumping units has been issued by the National Supply Co., Box 899A, Toledo, Ohio, U.S.A.

Biological Staining Methods, published at 1*s* by George T. Gurr, 136 New Kings Road, London, S.W.6, is designed as a ready reference to methods of staining microscopical specimens. The booklet contains a comprehensive index.

Ceramid, a new synthetic wax, is now available in commercial quantities. An alkyl stearamide, it is hard, light yellow in colour and melts between 79.5°-80.5°C. Samples and data from Glyco Products Co., Inc., 26 Court Street, Brooklyn, N.Y.

COUNCIL COMMENTARY

COUNCIL met at Manson House on November 9, 1949, and, as the President was still in America, H. Hyams was appointed to the chair from which he conducted proceedings in his usual genial and effective manner.

His first act was to propose and gain agreement that F. C. Hamilton, Chairman of the Trinidad Branch, who was at present in Britain, should be invited to sit-in during this meeting. He then welcomed Mr Hamilton to the meeting.

The minutes of the previous meeting were then confirmed and signed and matters arising from them dealt with.

In the absence of a written advice from counsel in connexion with our liability to income-tax, the General Secretary could only give an indication of counsel's probable opinion. It was decided, therefore, to await a formal letter before taking action, except that in the meantime information would be sought from other institutes.

All learned with regret that J. A. Oriel felt quite unable to accept his nomination as vice-president and it was decided to limit the number of vice-presidents for 1950 51 to five. It was also decided that in future an approach should be made to all eligible members before their names are subject to ballot.

T. Dewhurst reported, in connexion with the Permanent Council of the World Petroleum Congress, that the General Secretary had been authorized to prepare a draft constitution of the Congress for the next meeting.

H. Hyams reported his talk with Col. Auld in relation to the proposed oil exhibition in 1951 and Col. Auld, who was present, gave his views why it was not practicable to hold such an exhibition in 1951.

A proposed social evening was discussed and various decisions were left to the *ad hoc* panel of Publications Committee.

The Election Committee report, which was presented by G. H. Thornley, included heartening news about company subscriptions. The General Secretary was instructed to express to the chairmen of the companies concerned the Council's appreciation of their generous support.

Attention was drawn to the fact that many members were still in lower grades of membership than those for which they would appear to be qualified. It was decided to insert a notice in the Journal with the object of inducing fully qualified associates to apply for upgrading. The Election Committee were asked to draft this notice and also to recommend possible action in regard to Member Fellow transfers.

F. C. Hamilton, who had that morning attended an Election Committee meeting, expressed his opinion that he would now be able to clear up quite a number of misunderstandings between the Trinidad Branch and the parent body.

Mr Hyams indicated that any member of the Trinidad Branch Committee when in Britain would be welcome to attend meetings of the Election and Branches committees.

Various staff matters arising from recommendations of the Joint House and Finance committee meeting were then discussed, attention being drawn to the possibility of some economy in the reporting of technical matters.

The Finance Committee report was tabled by H. Hyams and approved. A Committee consisting of Col. S. J. M. Auld, C. T. Brunner, C. Chilvers, and H. Hyams, was empowered to deal with certain aspects of subscriptions.

Arrangements for the annual dinner were discussed, but not to finality. An *ad hoc* committee consisting of the President, C. A. P. Southwell, and C. T. Brunner was appointed.

The Branches Committee report was left over, and the proceedings concluded.

PETROLEUM IN PARLIAMENT

Marshall Aid Petrol

The Minister of Fuel and Power was asked on November 21 what quantity of petrol is being purchased with the £19,545,000 just allocated for this purpose under the Marshall Aid grant; the total quantity to be received during the current year through Marshall Aid; and the total amount allocated annually under the basic petrol scheme.

The Parliamentary Secretary, in a written reply, said: The Economic Co-operation Administration has in recent months allocated $68.6 million for the purchase of crude petroleum and petroleum products by the U.K. in the second half of 1949; it is estimated that these purchases will include 738,000 tons of motor spirit. Total allocations by the E.C.A. for the purchase of petroleum in 1949 are $133.2 million and it is estimated that these purchases will include 1,705,000 tons of motor spirit. The total amount of petrol, including the "Summer bonus", represented by Standard Ration coupons which it is estimated will be issued during 1949, is approximately 470,000 tons.

Oilfield Machinery

Asked how much oilfield machinery had been exported or offered to the U.S.S.R., the Secretary for Overseas Trade said on November 22, in a written reply: Machinery intended primarily for use in oilfields is not separately distinguished in the U.K. Trade and Navigation Accounts. Production is at present insufficient to meet all the requirements of British oil companies who are still having to meet part of their needs from the United States. I should doubt, in these circumstances, whether any of this equipment can have been offered to Russia.

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Correspondence on matters of general interest will be welcomed for inclusion in the *I.P. Review*.

TANKER IN LORD MAYOR'S SHOW

"Transport through the ages" was the theme of the 1949 Lord Mayor's show. Included in the 300-yard long procession which accompanied Sir Frederick Rowland, the new Lord Mayor, through the streets of London on November 9, was a float carrying a model of one of the Anglo-Saxon Petroleum Company's new 28,000 ton tankers.

This exhibit recalls the name of Marcus Samuel, first Viscount Bearstead, who not only was largely responsible for the initial development of the Shell fleet, but was also London's Lord Mayor from 1902-3. Since 1890, when Marcus Samuel ordered the *Murex*, of 5010 dw.t., the tonnage of Shell's fleet has steadily increased, despite war losses.

SHELL GROUP FLEET*

	No. of vessels	*dw.t.*
1899	14	85,000
1914	64	266,000
1930	170	971,000
1939	222	1,965,000
1949 (Sept. 1)	242	2,207,000

*Control of the Shell fleet is vested in a number of companies, the principal being Anglo-Saxon Petroleum Co. Ltd.

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Aircraft Fuel Supplies.—The Motor Fuel (Overseas Aircraft) Licence and Direction, 1949, which came into operation on November 7, is available from H.M.S.O., price 1*d*.

I.P.C. CONSULTANT

Morgan Walker, who has been appointed consultant to the Iraq Petroleum Co. Ltd. in succession to the late H. S. Austin, was in charge of the first welded pipeline constructed in Eastern Venezuela by Creole Petroleum Corpn in 1929. He also assisted in the design and construction of the first 16-inch line. As technical assistant to Eugene Holman, Standard Oil Company of New Jersey, he built the first pipeline in Hungary. In 1948 he visited Saudi Arabia in connexion with the trans-Arabian pipeline and opened his own office in New York in April 1949.

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OIL EDUCATION

Three useful charts (each 38 in by 28 in) explaining the principles of petroleum technology in an elementary way, have just been issued by the Petroleum Information Bureau. The first—"Searching for Oil"—illustrates various kinds of oil traps, geological and geophysical methods, and coring. Drilling methods on the second chart are explained by means of a section of a rotary rig, with insets on various features, including production methods. The last chart is on refining; it outlines the flow of crude oil through a fractionating tower and indicates how the various fractions are purified to produce usable materials.

Printed in two colours, the charts are obtainable from the P.I.B., 29 New Bond Street, London, W.1, price 4*s* 6*d* the set.

PERSONAL NOTES

E. A. Evans, President of the Institute, has been elected vice-chairman of the Automobile Division of the Institution of Mechanical Engineers.

E. V. Murphree, President of the Standard Oil Development Co., New York, has been awarded the Perkin Medal by the American Section of the Society of Chemical Industry. This medal, founded to commemorate the 50th anniversary of the coal tar industry, is given annually for outstanding work in applied chemistry.

V. Biske, F.Inst.Pet., has recently been awarded the degree of Master of Laws.

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BRIAN R. MUIRHEAD

It is with regret that we record the death on October 20 last of Brian R. Muirhead, vice-president and treasurer of Universal Oil Products Co. Well-known in the petroleum industry, he was particularly active in the last war in the construction of petroleum defence plant facilities. He joined UOP in 1945. Previously he was treasurer of Arkansas Natural Gas Corporation.

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A gold "Oscar of Industry" for the best annual report in the U.S.A. was awarded to Standard Oil Company (New Jersey) for their 1948 report. Mr Frank W. Abrams, Chairman of the company, is seen receiving the trophy from Mr Weston Smith, of the Financial World.

SIGNIFICANCE OF PROPERTIES OF PETROLEUM PRODUCTS

VII. TESTS OF ENGINE FUELS

By R. STANSFIELD (Fellow)

The Relation between the Fuel and the Engine

The behaviour of an internal combustion engine depends to a large extent on the skill with which it was designed, on the selection of the materials from which it was made, and on the accuracy and type of workmanship put into its parts.

If an engine is built with an unsuitable crankshaft it may fail at loads and speeds which would otherwise be well within its capacity. If it is fitted with pistons which have too small a working clearance its maximum speed and power may be severely restricted, and, in an extreme case, it may not be possible for it to run at all.

This dependence of performance on design, materials and workmanship is well recognized. It is not always appreciated, however, that the fuels and lubricants used in engines must really be considered as though they too were materials of construction requiring the same careful selection and testing, and only giving the best results when the conditions imposed by the engine are also suitable.

The user of an automotive engine is interested in several fuel characteristics. Starting must be easy in cold weather; the engine should not have to run too long before it responds quickly to throttle opening; combustion should be complete so that the lubricating oil remains undiluted, and there should be no risk of the fuel system or carburettor choking with vapour under high temperature conditions. In addition, the fuel must burn smoothly without heavy detonation or knock if it is to be acceptable.

Knock or Detonation

Knock in an automotive engine makes the driver change gear more frequently than would otherwise be necessary and so leads to an increased petrol consumption. In an aero engine the existence of detonation for more than a few minutes can cause piston burning and engine failure. Knock is also objectionable in diesel engines, and a diesel fuel which does not ignite easily and then knocks badly may also be troublesome to start from cold.

With the exception of the determination of anti-knock value the majority of the tests required to ensure that motor and diesel fuels will be satisfactory can be made in the laboratory, but measurement of knock characteristics requires the use of special engines run under conditions which are strictly controlled to suit the particular test which is being made.

Knock Testing of Petrols

The design of engines for the knock testing of automotive petrols is based on the fact that knock can be induced with any petrol if the engine is run with a suitably high compression pressure, and all modern test units are therefore constructed so that the compression ratio can be adjusted over a wide range as required.

A photograph of an A.S.T.M-C.F.R. knock testing engine is shown in Fig. 1. It is a single cylinder unit coupled to a dynamometer which absorbs the power output and keeps the engine running at the speed appropriate for the particular test which is being made. The cylinder position can be adjusted to alter the compression ratio while the engine is in

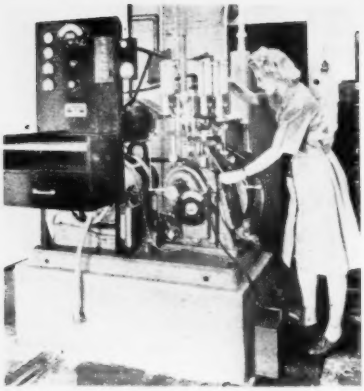

Fig. 1. An A.S.T.M - C.F.R. knock testing engine.

motion. The air inlet temperature, the mixture temperature, and the mixture strength are under control, and the carburettor is made so that it is possible to change quickly from one to another of three or four different fuels.

Effect of Running Conditions

Assume first that the test engine is run relatively slowly at full throttle with the inlet temperature low and the fuel supply adjusted to give about the chemically correct mixture of fuel and air for complete combustion. If the compression ratio is raised sufficiently, knock or detonation will begin. It can be suppressed by raising the speed, by cooling the inlet air, by partial closing of the throttle, by making the mixture richer, by making it weaker, and by over-retarding the ignition setting. With the exception of the first two, each of these alternatives reduces the power output and efficiency of the engine.

Effect of Fuel Type

Assume next that two fuels are used in turn and that these are of different chemical types but so chosen that they give equal knock when run under the arbitrary conditions of the first test. If a comparison is made between the response of one of these fuels and that of the other to the effects of each of the variables referred to above, it will usually be found that they behave differently. For example, two fuels may detonate with equal intensity at low inlet air temperature but at different intensities when the mixture is heated.

The consequence of this behaviour is very important. It means that the knock rating of two petrols, either in an engine running on the road or in a laboratory test engine, may be the same under certain conditions of use but different under other conditions: it means that two petrols may give identical knock in one type of engine but they may differ in another, and it makes the use of strictly standardized conditions essential for laboratory work.

Reference Standards

In order to give numerical values to knock ratings two pure hydrocarbons have been chosen as reference fuels, *n*-heptane and *iso*octane. Heptane knocks at very low compression ratios and octane gives no knock in any engine at present in general use on the road. All commercially available motor fuels lie somewhere between these extremes and it is therefore possible to make a blend of heptane and octane which will match the knock of a given petrol sample under any selected set of test conditions. If a blend of say 70 per cent of octane with 30 per cent of heptane by volume gives the same knock as the sample in the test engine then, for these particular conditions, the sample is said to have an octane number of 70.

Test Methods for Motor Fuels

To-day it is usual to make two different tests in the C.F.R. engine; for one, the Motor Method test, the engine speed is 900 r.p.m. and the mixture temperature, 300 F. For the other, the Research Method, the speed is 600 r.p.m. and the inlet air is heated to 120 F without

further mixture heating. In both methods the cylinder jacket coolant temperature is 212° F. The mixture strength is adjusted to give maximum knock, the compression ratio is set to give a standard intensity of knock measured by an instrument known as the bouncing-pin, and the ignition advance is controlled to suit the compression ratio. There are minor differences in detail between the engine assemblies used for the two tests and they are described in the Standard Instructions.

The Motor Method rates fuels roughly in the same order as they are rated in a car on the road when it is running at a moderate to high speed; the Research Method rates them more nearly in the order of their low speed road ratings. These parallels are not precise but they give a good average indication of service behaviour.

Test Procedure

When making an octane number determination a sample is put into one of the three or four feed vessels with which the carburettor of a C.F.R. engine is fitted, and the engine is run on this fuel at the proper speed and mixture temperature for the type of test being made. The compression ratio is adjusted by lowering the cylinder until a standard knock intensity is reached, the knock being measured with the aid of a bouncing-pin or some other form of detonation-sensitive instrument.

The mixture strength is then adjusted to give maximum knock; at this setting either increase or decrease in mixture strength causes the detonation to be reduced and the meter reading to fall, and the compression ratio may have to be readjusted to bring the knock meter reading within specified limits. It is now possible to estimate the approximate octane number of the sample from the compression ratio at which the cylinder has been set. Suppose, for instance, that this estimate is 75 octane. A blend of 75 parts of octane and 25 parts of heptane is put into one of the other feed vessels and the fuel change-over cock turned so that the engine runs on this blend. After a minute or two which must be allowed for the detonation to become steady on the different fuel the mixture strength is adjusted so that the knock meter reading reaches a maximum. If the standard blend exactly matches the sample, the knock meter reading will be the same on each fuel, but usually there will be a small difference showing that the sample is either a little higher or a little lower than 75 octane. A second blend of standards is then made of 77 or 73 octane number so that the sample is bracketed, and the meter reading is determined as before.

Three or more readings are taken from each fuel and the exact octane number of the sample is calculated from the relation between its mean knock meter reading and those of the standards which bracket it.

Anti-knock Tests of Aviation Fuels

Anti-knock ratings of aviation fuels are more difficult to determine and two different methods of test are always used, one to give the weak mixture rating required for cruising conditions, and the other to ensure suitability for take-off when the engine is running with maximum supercharge. The weak mixture test may be made by the Motor Method of operation but with the ignition fixed at 25° advance. United States' practice is to use different conditions of speed and mixture temperature and to measure the knock by means of a special thermo-couple, used in place of the bouncing-pin. As many aviation fuels have an octane number above 100, the use of heptane-octane standard blends is supplemented by octane with tetra-ethyl lead (T.E.L.) or octane/heptane/T.E.L. to give the necessary extension of the rating scale.

Rich mixture ratings of aviation fuels are determined in a supercharged C.F.R.

engine with the compression ratio fixed at 7 : 1 and the cylinder cooled with ethylene glycol. The speed for this test is 1800 r.p.m. and knock may be measured either by ear or a special electrical pick-up. The engine is run first without supercharge and the mixture strength adjusted from rich to weak. If there is no knock a slight supercharge is applied and the process is repeated until a light standard of knock is obtained. Readings of power output and fuel consumption are then taken. The mixture is then enriched; this suppresses the knock, which is restored to the standard intensity by increasing the supercharge when further power and consumption ratings are taken. A succession of such tests enables a curve to be drawn which shows that the knock limited power output rises sharply at first, flattens out, and then starts to fall. Acceptable fuel must give a maximum power which is not less than that reached by a specified blend of octane and T.E.L., or which is a specified percentage of the power reached by a suitable blend.

Just as it is necessary to make road tests of motor fuels from time to time to enable laboratory ratings to be used intelligently, so must reference be made occasionally to full scale tests of aviation fuels to check the validity of the laboratory methods. These are not to be regarded as final for all time, but only as approximations to the most critical current needs, and subject to change if justified by advances in engine design.

Diesel Fuels

When fuel burns in a petrol engine the flame travels from the spark plug across the combustion chamber in a more or less regular manner, heating the unburnt charge ahead as it proceeds. Under the influence of pressure and temperature the mixture undergoes chemical changes which lower its ignition temperature, and knock takes place if this results in spontaneous ignition of the end gas.

In the case of a diesel fuel, combustion does not start until low ignition temperature compounds are formed under the influence of the heat of compression. Chemical instability of the fuel which leads to knock and is undesirable in the petrol engine, is a necessity for a diesel fuel.

A good diesel fuel starts to burn at several places in the combustion chamber soon after the beginning of injection. Once the flame is established any further fuel which enters the cylinder ignites almost as it is injected. If the delay between the beginning of injection and the beginning of combustion is long, it is possible for the whole of the fuel charge to be in the cylinder before burning starts, and then the combustion is violent and heavy knock is experienced.

The object of engine tests of diesel fuels is to determine ignition quality as a measure of easy starting and freedom from knocking tendency, and such tests depend on the measurement of the combustion delay in terms of degrees crank angle.

Engine Tests of Diesel Fuels

Engine requirements and running conditions for diesel fuel testing do not need the same close control as the conditions for the anti-knock testing of petrols, although, of course, once the test conditions have been fixed for a particular unit they must be held precisely for the samples and the matching blends of standards or secondary standards.

In order to have a standard reference scale the samples are matched against blends of cetane and alpha-methylnaphthalene, the percentage of cetane by volume in such a blend being the cetane number of the fuel. For routine tests, suitable secondary reference fuels of high and low ignition quality are employed. The Institute of Petroleum permits the use of any suitable engine for tests of diesel fuels.

A C.F.R. diesel engine with a variable

compression combustion chamber may be used and tests for ignition quality are made in the following manner:

The engine is run at a constant speed of 900 r.p.m. with evaporative cooling of the cylinder jacket and cylinder head. The inlet air is heated to a temperature of 150° F and the fuel pump is set to inject 13 cc of fuel per minute. The injection timing is adjusted so that the spray valve lifts 13° before T.D.C. and the compression ratio is set so that combustion starts at top centre. Low ignition quality fuels require a high compression ratio, and high ignition quality fuels a low ratio, to obtain the 13° delay angle between the beginnings of injection and combustion. Compression ratios are determined which give this 13° delay for each of a number of reference fuel blends of known cetane number, and the curve obtained from the results is applied to give the cetane numbers of test samples, which may finally be checked by bracketing between suitable blends of reference fuels.

When tests are made in a diesel engine with a fixed compression ratio it is usual to run the engine on a series of reference fuel blends and to measure the delay angle between the beginning of injection and the beginning of combustion with some form of engine indicator. A curve can then be plotted correlating delay with cetane number and samples rated according to the delay angles determined for each. These calibration curves need to be checked daily as they change slightly with engine condition.

An alternative method of test depends on fitting the engine with an inlet expansion chamber and a throttle valve and throttling on each fuel until misfiring occurs as indicated by a puff of white smoke from an exhaust test cock. The pressures in the inlet surge chamber may be measured with an ordinary Bourdon gauge and correlated with the cetane number at which misfiring occurs.

Other qualities of diesel fuels which may affect nozzle carbon formation and exhaust smoke depend too much on the design of the particular engine in which the fuels are used to be suitable for determination by simple routine methods.

References

Details of the methods used for the engine testing of motor and diesel fuels are given in "Standard Methods for Testing Petroleum and its Products" published by the Institute of Petroleum, and in the "A.S.T.M. Manual of Engine Test Methods for Rating Fuels". An account of the behaviour of a petrol engine when running under detonating and non-detonating conditions at various compression ratios and on a number of different fuels is included in the Empire Motor Fuel Committee Report, (*Proc. Inst. Auto. Engrs*, 1923, **18**, Part 1) and this is still worth careful study. The subject of detonation is dealt with in several articles in the *Science of Petroleum*, Oxford University Press, and each year there are descriptions in the *S.A.E. Journal* of research on knock testing and the behaviour of fuels under road conditions. Apart from the instructions in the Standard Methods manuals there are no recognized standard publications on the subject.

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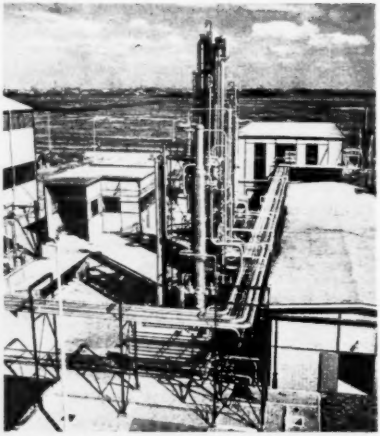
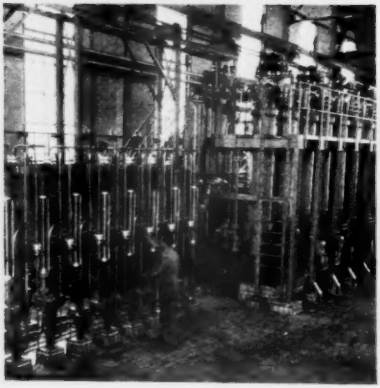
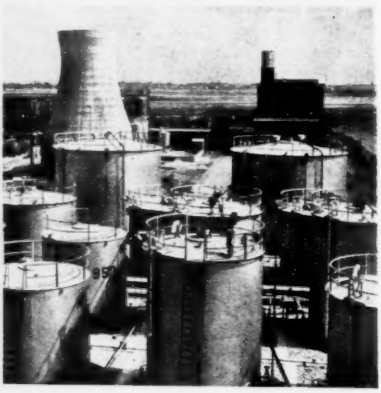
ENGINEERS WANTED

PETROLEUM ENGINEERS required for Bahrein Petroleum Co. Ltd. (a) **Production,** with over five years experience in reservoir engineering research or in performance data for wells in the observation and use of depth pressures, etc.; (b) **Mud Engineering,** with over five years experience this type of work; (c) **General,** with over five years experience drilling and re-drilling and repair of producing wells; (d) with **Geological** qualifications additional to (c). Age limit 40. Free board, air conditioned quarters, and medical attention plus 10 per cent of salary for married employees during initial two years separation period. Low living costs, paid leaves. Write with full particulars age, experience, education, salary required to Box 3221, c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4.

PETROCHEMICALS IN HOLLAND







In September the Netherlands Minister of Economic Affairs formally opened the new chemical plants erected at Pernis, Rotterdam, by the Bataafsche Petroleum Mij. These plants will produce ester salts and polyvinyl-chloride and mark a further stage in the Royal Dutch/Shell Group's programme in the petroleum-chemical field.

Raw material for this plant will be by-product gases from the nearby Rotterdam refinery of the company. This refinery is being extended and will provide all the raw materials for the chemical plant by 1952. The refinery extensions include a distillation unit of 6000 tons daily intake, high vacuum installation, catalytic cracker of 3000 tons/day capacity, and reforming unit.

The photos show (top left) *piping between pumphouse and distillation unit of the P.V.C. plant;* (top right) *distillation columns and pumphouse in the P.V.C. plant;* (bottom left) *inside a polymerization unit;* (bottom right) *tank storage at the ester salts plant.* (Shell photographs.)

AUSTRALIAN PETROLEUM INDUSTRY

In a report dated August 1949 prepared by the Division of Industrial Development of the Australian Department of Post-War Reconstruction, some interesting information regarding the Australian petroleum industry is given. This is summarized below.

After a general introduction on the technology of refining, the market situation is discussed.

Gasoline

Pre-war the annual consumption of motor spirit in Australia was about 360 million gallons. In 1948, although limited by rationing, it amounted to 408,439,000 gallons.

Comparative figures of motor registrations are: motor cars, March 31, 1949, 641,073 (562,271 on June 30, 1939); commercial vehicles, 442,229 (258,025); motor cycles, 113,200 (79,237). On this basis current annual motor fuel demand is about 500 million gallons and is expected to rise strongly until a significant change in general economic activity occurs.

For the year ended March 31, 1949, aviation spirit consumption was 92,000 tons. In 1947/8 the figure was 89,000 tons, and in 1938/9, 16,500 tons. Present demand is estimated at 110,000 tons per annum, made up of 2500 tons of 73 octane spirit, 52,500 tons of 91 octane, and 55,000 tons of 100 octane.

Kerosine

Demand for power kerosine pre-war was about 44 million gallons. Current demand is 80 million gallons, of which 74 million gallons would be required for tractors. The remainder is mainly for stationary engines.

Kerosine for lighting and heating was used to the extent of about 17 million gallons yearly before the war. Present annual demand is 30 million gallons, and, apart from increased use for refrigeration, development of jet engines is a factor in future demand.

Gas Oil

Consumption of gas oil in Australia pre-war was estimated at 35,000 tons. In 1946/7 consumption was below demand at 91,000 tons, i.e. 36,500 for tractors, 30,000 for stationary engines, 23,500 for automotive purposes, and 1000 tons for bunkers. Current annual demand is estimated at between 150,000 and 160,000 tons.

Diesel Oil

In 1946/7 diesel oil consumption was below demand and amounted to 295,000 tons for heat-raising, 150,000 for stationary engines, 20,000 for tractors, and 102,000 for ships' bunkers, a total of 567,000 tons.

Estimated demand is 660,000 tons per annum, with 115,000 to 120,000 tons for bunkers and 50,000 tons for gas-making.

Fuel Oil

Current annual demand for fuel oil amounts to about 675,000 tons, of which 150,000 tons is for purposes other than bunkering. Many locomotives in New South Wales and in Victoria are oil-fired. Pre-war total consumption was 209,000 tons yearly.

Lubricants

Annual demand for lubricants, which is expected to increase by about 10 per cent in the next twelve months, is given as 13 million gallons (6,800,000 pre-war) of industrial lubricating oils, 20,500,000 gallons (9,700,000 pre-war) of automotive lubricating oils, and 11,000 tons (5,400 pre-war) of greases.

Bitumen

It is estimated that 90 per cent of the current annual demand for 100,000 to

110,000 tons of bitumen and asphalt is used by State and municipal authorities for road maintenance and construction. Demand will rise sharply when construction shortages are overcome.

Total Demand

Present total demand for petroleum products—3,897,000 tons—is over 70 per cent higher than pre-war and the upward trend seems likely to continue. About 16 per cent of the country's requirements of refined petroleum are obtained for local refineries.

Refineries

Five companies are engaged in petroleum refining in Australia. They are:

Bitumen and Oil Refineries (Australia) Ltd., Botany, N.S.W.
Commonwealth Oil Refineries Ltd., Laverton, Victoria.
National Oil Pty Ltd., Glen Davis, N.S.W.
Shell Co. of Australia Ltd., Clyde, N.S.W.
Vacuum Oil Co. Pty Ltd., Paisley, Victoria.

The Vacuum refinery commenced operations in July 1949 and Shell has decided to build a refinery at Geelong, Victoria.

Refinery output in 1948 with an estimate of present output and an estimate of potential output are given in Table I.

TABLE I
AUSTRALIAN REFINERY OUTPUT

	1948 *output tons*	*Estimated present output tons year*	*Estimated potential output* * *tons year*
Motor spirit †	216,200	266,000	295,500
Aviation spirit	—	—	—
Power kerosine	12,000	12,000	13,500
Lighting kerosine	—	—	—
Gas oil	24,000	42,000	55,000
Diesel oil	1,950	35,000	41,000
Fuel oil	134,550	222,000	225,000
Lubricating oil	—	15,000	18,000
Bitumen	29,100	46,000	70,000
Greases	10,600	11,000	12,000
	428,400	649,000	730,000

* Based on operation at 85 per cent capacity.
† Including benzole, power alcohol, and solvents.

During the year 1947 8 inputs of crude petroleum for refining amounted to 83,945,097 gal and in the nine months to March 1949 the quantity was 101,415,484 gal. Indigenous shale oil is also a source of crude oil.

Oil Exploration

No large deposits of petroleum have yet been found in Australia. Prior to 1942 the principal areas of oil exploration were Papua and New Guinea, southern Queensland, and Gippsland, Victoria.

In Papua-New Guinea, surveys and test drillings have been made by the Australasian Petroleum Co. and a well at Kariava reached 12,621 ft without any indication of oil. Drilling is now in progress at Oroi, near Yule Island, and at Upoia and Hohoro on the Vailala River.

In southern Queensland gas was found at Roma in 1900 at 3683 ft and has been struck since on many occasions, but not in commercial quantities. In 1940, Shell (Queensland) Development Co. commenced exploration in south-western Queensland and this work was recommenced after the war. A promising structure has been found at Warrinella and a deep test is about to be started.

In Victoria, drilling at Lakes Entrance found small quantities of low-grade crude oil..

Wells have been drilled in various other localities and further large-scale operations are projected in Dampier Land, the Kimberleys area, and the North-west Basin.

Since exploration started, at least 268 test wells have been drilled with an aggregate footage of 463,200 ft. During 1948 surveys accounted for the following crew months: Seismic, 2 in Papua-New Guinea; Gravity, 8 in Australia and 12 in Papua-New Guinea; Magnetic, 8 in Australia and 6 in Papua-New Guinea; Geological, 56 in Australia and 70 in Papua-New Guinea.

Shale Oil

It is estimated that no more than 50 million tons of oil shale of all grades exist in Australia. Over half are in New South Wales at Newnes-Glen Davis (20 million tons) and Baerami-Widdin (10 million tons). Glen Davis is being mined at about 135,000 tons annually.

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Emergency Lighting. — "Safetylite" emergency lighting equipment is described in a catalogue, illustrated by photographs and diagrams, which is available from the Tudor Accumulator Co., 50 Grosvenor Gardens, London, S.W.1.

Electronic control of oil and gas-fired furnaces is the subject of a booklet issued by Elcontrol Ltd., 28a Tilehouse Street, Hitchin, Herts.

SAFETY CONFERENCE

Among the papers presented at the Association of British Chemical Manufacturers Works Safety Conference, held last October at Scarborough, was one on "Toxicity of Solvents" by Arthur J. Amor, M.D. The author, who is president of the Association of Industrial Medical Officers, first laid down the main causes of poisoning and then dealt in greater detail with the effects as observed in industry of groups of solvents—alcohols, amides and amines, esters, ethers, furans, glycols, halogenated compounds, hydrocarbons, ketones, nitriles, nitrohydrocarbons and sulphur derivatives.

Another paper, by S. W. Richards of the General Electric Company, dealt with "Permissible electrical apparatus for use in hazardous atmospheres".

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"STANDARD METHODS FOR TESTING PETROLEUM AND ITS PRODUCTS"

Twenty-five years ago the Institute of Petroleum (then the Institution of Petroleum Technologists) published the first edition of its "Standard Methods for Testing Petroleum and Its Products". This was a modest volume of 102 pages, describing some forty methods of testing petroleum products.

Throughout the intervening years, much work has been carried out on the subject of testing petroleum. In addition, new products have been brought into being and new applications have demanded the formulation of special methods to determine the suitability of these products for specified purposes. Thus, the size of this book, the tenth edition of which is just published, has grown to 660 pages of data describing in detail the apparatus for and the procedure of 116 methods for determining physical and chemical properties of crude petroleum and its products. The properties for which tests are available are extremely wide in range, varying from specific gravity to setting point, from salt content of crude oil to residue on sieving bituminous emulsion.

Compared with the previous (1948) edition, there are numerous changes, and these are listed in the preliminary text of the book. The three new methods are of considerable importance. They are: (1) an engine method of testing heavy-duty lubricants in relation to ring-sticking, wear, and deposit accumulation; (2) a method for Research octane number of motor fuels; (3) a method of assessing the corrosive tendencies of cutting oils in contact with cast iron.

Various methods have been revised in detail, including calorific value (now known as heat of combustion), distillation, viscosity, etc, while many editorial amendments have been made to avoid ambiguity.

Copies are obtainable from the offices of the Institute at 31*s* post free.

FOURTH WORLD POWER CONFERENCE

The Fourth World Power Conference opens in the Central Hall, London, on July 10, and technical sessions will be held in London during July 11-14 at various centres in London. The closing session will take place at the Institution of Civil Engineers on the morning of July 15, and during the week commencing July 17 tours will be made to places of interest in the U.K.

The general arrangement of the Conference is in three main divisions: (i) Energy resources and power developments; (ii) Preparation of fuels; and (iii) Production of power. Among the papers to be presented the following appear to be of particular interest to the petroleum industry.

DIVISION II

Le problème de la fabrication des essences à haut indices d'octane. M. R. Perrin (*Cie Française de Raffinage*).

Les réalisations française en matière d'utilisation des gaz de pétrole liquéfies. M. Kaplan (*Shell Française*).

Problèmes posés par le developpement de la gazeification des combustibles liquides. M. Jacque (*Institut du Pétrole*).

L'exploitation et les utilizations du gaz naturel en France. M. Moch (*Régie Autonome des Pétroles*) and M. Wagner (*Gaz de France*).

Recent developments in petroleum refining. P. Fleming and T. Tait (*Anglo-Iranian Oil Co. Ltd.*).

The use of heavy petroleum fuels for the production of power. C. G. Williams, A. Wilson, and C. W. G. Martin (*Shell Petroleum Co. Ltd.*).

Fuels for high speed diesel engines. C. S. Windebank, L. D. Derry, and E. B. Evans (*Esso Development Co. Ltd.*).

The preparation and utilization of fuels from coal tar. D. McNeil (*Coal Tar Research Association*).

The recovery of benzole at gas works and at coke ovens. W. H. Hoffert and G. Claxton (*National Benzole Association*).

Le programme italien dans le domaine des gaz naturels.

The occurrence and exploitation of oil shales in South Africa. A. R. Stelling and G. G. Robertson.

Recent development possibilities by means of modern retorts for oil shale and modern boilers for shale coke. A Johansson and T. Hedback.

Advances in petroleum refining. W. M. Holaday (*Socony-Vacuum Oil Co. Inc.*).

Synthetic liquid fuels. W. C. Schroeder and A. C. Fieldner (*Bureau of Mines*).

Transportation, storage, and peak load supply of natural gas. George H. Smith (*American Gas Association*).

Manufacture of fuel and synthesis gas in the United States. L. L. Newman, L. D. Schmidt, and H. R. Batchelder (*Bureau of Mines*).

DIVISION III

Modes de production d'energie comportant l'emploi integral on partiel de turbines à gaz. M. Roy (*Commission de la Turbine à Gaz*).

Du choix des carburants dans les moteurs à combustion interne. M. Picard (*Régie Nationale des Usines Renault*).

Oil fired marine boilers. W. Gregson (*Babcock and Wilcox Ltd.*).

Recent developments in light weight spark ignition and compression ignition engines. W. A. Robotham (*Rolls-Royce Ltd.*)

Land-type gas turbines. D. M. Smith (*Metropolitan-Vickers Electrical Co. Ltd.*).

Summary of current developments in large diesel and gas engines. R. L. Boyer (*The Cooper-Bessemer Corpn*).

Snmmary of current developmer ts in small diesel engines. M. R. Bennett (*International Harvester Co.*).

American gas turbine practice. L. N. Rowley and B. G. A. Skrotski ("*Power*")

Aircraft gas turbines. J. S. Alford (*General Electric Co.*).

Details of the membership are obtainable from the Conference Offices, 414 Cecil Chambers, 76-86 Strand, London, W.C.2.

★ ★ ★

Slush Pump Lubrication.—The Ideal Fluid Piston Rod lubricating system for power slush pumps is now available for Ideal C-250 and C-150 power pumps, and for pumps of other makes. Description and specifications are given in a bulletin available from The National Supply Co., Box 899A, Toledo, Ohio, U.S.A.

U.S. PETROLEUM REFINERIE S

According to the U.S. Bureau of Mines Information Circular No. 7537, the number of petroleum refineries in the United States on January 1, 1949, was 375, a drop of 15 from the figure for 1948. Crude oil throughput capacity, however, increased during the year by 404,743 brl day, the increase being made up of 667,600 brl of new capacity less 262,857 brl of capacity retired. Thus the trend, which started in 1936, towards fewer units of larger capacity was continued. The crude oil capacity of the average refinery increased from 15,472 to 17,171 brl day during 1948.

Summary figures for the past 10 years are given in Table I. It should be noted that of the 375 refineries in existence on January 1, 1949, 336 with a daily capacity of 6,230,505 brl crude oil were in operation, the remaining 39 being shut-down. Three refineries were under construction, and the capacity of these, including extensions to existing plants, totals 341,500 brl day.

TABLE I
SUMMARY OF U.S.A. REFINERIES

Jan. 1	*Total number*	*Total crude oil capacity, brl day*	*Total cracking capacity, brl/day gasoline production*
1940	547	4,628,646	1,046,214
1941	556	4,718,969	1,103,048
1942	522	4,956,599	1,193,699
1943	471	4,902,011	1,189,343
1944	452	5,093,023	1,286,445
1945	413	5,301,153	1,487,914
1946	393	5,315,856	1,499,775
1947	399	5,569,482	1,514,622
1948	390	6,034,252	1,624,158
1949	375	6,438,995	1,715,273

Cracking Plants

As will be seen from Table I, the total capacity of cracking plants, expressed in terms of cracked gasoline production, has steadily increased during the last ten years. On January 1, 1949, it was 5.6 per cent higher than a year before and 136,602 brl day throughput was building.

Of the 1,715,273 brl day capacity at January 1, 1949, 603,536 brl was for catalytic plants, 821,462 brl for thermal, and 290,275 brl for reforming operations.

Details of capacities of all plants by States and owning companies are also given.

★ ★ ★

THE "COMET"

London to Tripoli and back in 6½ hours flying time was the feat accomplished recently in the 36-seater de Havilland "Comet", the world's first turbo-jet airliner. The "Comet", which is fitted with four "Ghost" turbo-jet power units, is designed for operation on world routes. Castel Benito, the airport of Tripoli, was chosen as the refuelling point for the "Comet's" first trial involving landing overseas, provision of fuel and lubricant being in the hands of Shell.

The "Comet", piloted by Group Captain John Cunningham, left London at 6.35 a.m. on October 25, 1949, on the 1489 miles flight to Castel Benito, arriving there at 9.53. The plane, which was refuelled while the crew breakfasted and rested, left Tripoli at 12.4 p.m., touching down at London airport at 3.19 p.m.

The Comet (above) on the eve of its first flight in July, 1949, and (below) being refuelled at Castel Benito. (Shell photos.)

At the Silver Jubilee Convention of the Swedish Advertisers' Association in Stockholm in November—K. C. Bussler general manager in Sweden of Anglo-Iranian Oil Co. Ltd. (right) with Tage Erlander, Prime Minister of Sweden. On the left is J. H. Brebner, O.B.E., chief P.R.O. of the British Transport Commission.

FIRE RESEARCH

Three interesting reprints from their quarterly *Journal* have just been issued by the Fire Protection Association. The first of these, J.R.3 "Fire research organization" by S. H. Clarke, deals mainly with the work carried out at the Boreham Wood fire testing station by the Joint Fire Research Organization. In the second, J.R.4 "Building boards in relation to fire protection" by R. C. Bevan, the properties of building boards which need to be considered in selecting boards are discussed. A table of the fire resistances of various boards is given. In J.R.5, "Fire resistance grading of elements of structure", are set out in tabular form the degree of protection required for structural steelwork, the materials and thickness required to attain various grades of fire resistance in walls and partitions, and of floors and roofs.

Copies are obtainable from the Association, at 84 Queen Street, E.C.4.

★ ★ ★

Watts Microptic Theodolite No. 2 is the subject of an illustrated brochure which will be sent on application to Hilger and Watts Ltd., 48 Addington Square, London, S.E.5.

SCOTTISH BRANCH

Domestic Heating

Dr E. A. C. Chamberlain, Divisional Chief Scientist of the National Coal Board (Scottish Division), gave a lecture on "Domestic heating" to the Scottish branch on October 7. Mr Robert Crichton, J.P., was in the chair.

The lecturer traced the history of domestic heating in Britain from the days of the Roman occupation, analysed present-day practice and the efficiency of heating methods in current use and spoke of the newer methods of heating from the viewpoint of both comfort and economy.

Pressure Vessels

Under the chairmanship of Mr Robert Crichton, J.P., Managing Director of Scottish Oils, Ltd., a meeting of the Scottish Branch was held in the Engineering Centre, Sauchiehall Street, Glasgow, on Wednesday, November 2, 1949. On this occasion Mr A. C. Vivian, of the Anglo-Iranian Oil Company's Engineering Division, gave a talk on "Pressure Vessels". (See *I.P. Review*, 1949, pp. 161-6.)

Mr Robert Gourlay and Dr W. M. Cumming contributed to the discussion which followed.

A vote of thanks to the lecturer was proposed by Mr John MacWilliam, chief engineer at Grangemouth Refinery, while Mr R. C. Thomson of the Anglo-Iranian Oil Co. proposed a vote of thanks to the chairman. Over fifty members and friends attended the meeting.

★ ★ ★

"Fibreglass".—The largest single use to date of "Fibreglass" Staple Tissue is that in connexion with the Iraq Petroleum Co's 16-in Kirkuk-Tripoli pipeline. To protect this 620-mile pipe some 14 million sq. ft. of Staple Tissue is required.

FORTHCOMING MEETINGS

INSTITUTE MEETINGS

Heysham Refinery—A Study in Adaptability. A. W. W. Kirby. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), February 8.

The Importance of the Preservation and Packing of Equipment for the Oil Industry. D. A. Williams. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), March 8.

LONDON BRANCH

Distribution and Marketing in the U.K. C. M. Merrick. At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*), February 22.

Refining and Processing.—R. B. Southall. At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*), March 30.

NORTHERN BRANCH

The Petroleum Industry as a Career.—A symposium by J. Dugdale Bradley, Prof. F. Morton, and Miss C. F. M. McIntosh. At Engineers' Club, Albert Square, Manchester, 6.30 p.m., February 21.

Petroleum in Agriculture.—F. Ellis. At Engineers' Club, Albert Square, Manchester, 6.30 p.m., March 21.

SCOTTISH BRANCH

Motor Racing.—E. A. Evans. At Engineering Centre, Glasgow, 7.30 p.m., February 1.

Nuclear Fission.—Sir Wallace Akers. At North British Station Hotel, Edinburgh, 7.30 p.m., February 23.

SOUTH WALES BRANCH

Annual General Meeting.—At Britannic House, Llandarcy, 5.30 p.m., February 7.

STANLOW BRANCH

Production and Purification of Low Molecular Weight Olefins.—H. Steiner. At Grosvenor Hotel, Chester, 7.15 p.m., February 15.

The Role of the Process Engineer in the Petroleum Refinery.—C. C. Wuth. At Grosvenor Hotel, Chester, 7.15 p.m., March 15.

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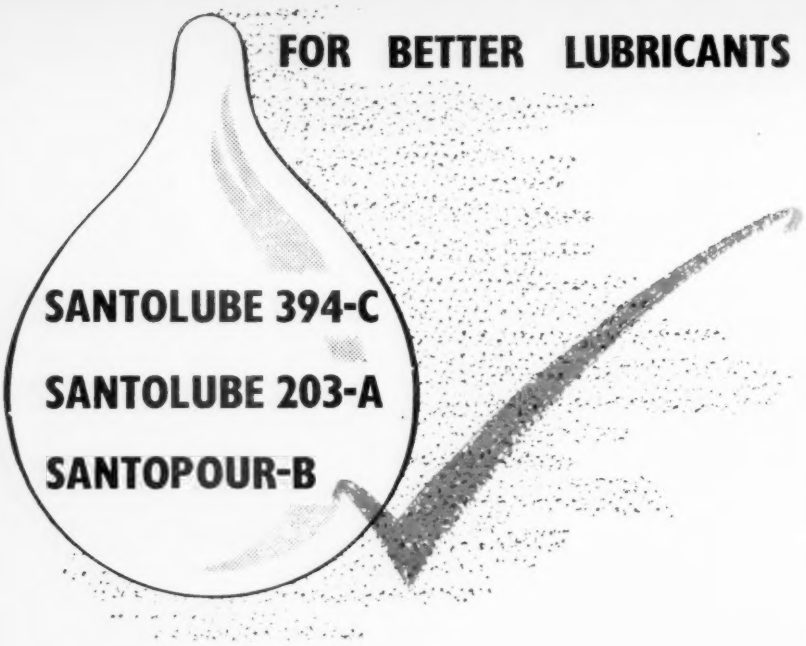

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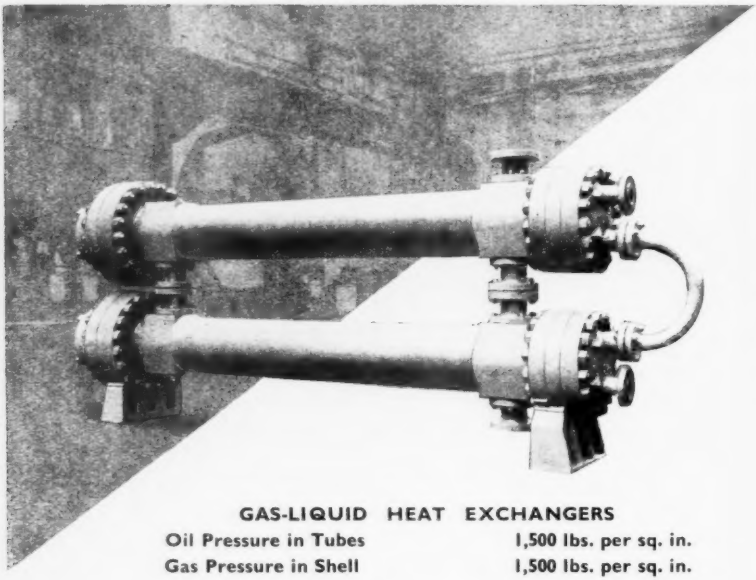

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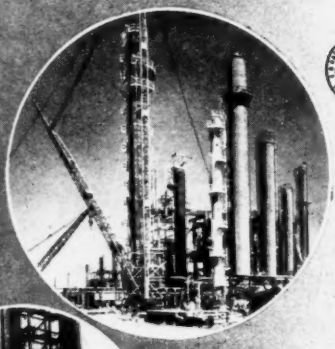

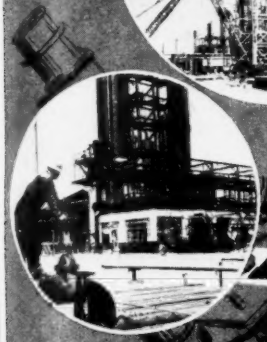

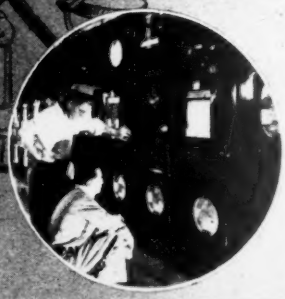

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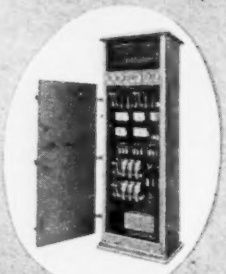

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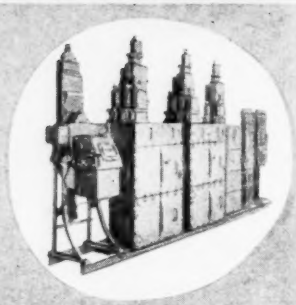

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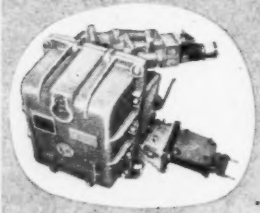

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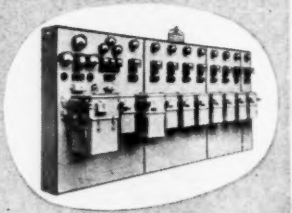

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